**Outcomes of pancreaticoduodenectomy with venous resection: a single center experience with 11 cases**

**ABSTRACT**

**Aim:** To perform a retrospective evaluation of the morbidity and mortality rates and reliability of venous resection with pancreaticoduodenectomy (PD) procedures in our clinic.

**Material and Method:** The records of 11 patients who underwent PD with venous resection between May 2016 and May 2021 in the Eskişehir Osmangazi University Faculty of Medicine Department of General Surgery were analyzed retrospectively.

**Results:** Eleven patients (five women and six men) were included. The patients’ mean age was 64.09±9.27 years (range 47-78). Eleven patients (five women and six men) were included. The patients’ mean age was 64.09±9.27 years (range 47-78). Four (36.36%) patients underwent type 1 reconstruction, one (9.09%) type 2 reconstruction, five (45.45%) type 3 reconstruction and one (9.09%) type 4 reconstruction. Eight (72.73%) patients experienced venous invasion according to the histopathology reports. Mean time between diagnosis and surgery was 14.91±11.33 days, and the mean follow-up time was 17.64±13.31 months. Grade C pancreatic fistula was observed in one (9.09%) patient, who died on the 17th postoperative day. No patients experienced recurrence or metastasis during surveillance.

**Conclusion:** Pancreaticoduodenectomy with venous resection-reconstruction is safe and the only curative option in patients with pancreatic cancer and venous invasion.

**Keywords:** Pancreaticoduodenectomy with venous resection, portal vein resection, pancreaticoduodenectomy

**INTRODUCTION**

Pancreaticoduodenectomy (PD) is a complex, high-risk surgical procedure. The best operative mortality rates and long-term outcomes are reported from high-volume centers (1, 2). The mean operative time for the PD procedure is 5.5 hours, mean blood loss is 350 mL, and operative mortality is less than 4% in experienced centers (3).

Venous resection is not performed in most PD procedures. Venous involvement was at one time a relative contraindication for curative resection. However, experience with vein resection in hepatobiliary surgery began to emerge a few decades ago. Results following the perioperative period results were similar in PDs with venous resection, and venous resection procedures became more practicable (4).

One of the leading case reports concerning PD with venous resection was published in 1951 (5). Those surgeons observed invasion of the tumor to the lateral wall of the superior mesenteric vein (SMV) during surgery and performed segmental SMV resection end-to-end anastomosis. Numerous resection-reconstruction methods were subsequently described, and various inferences were drawn. These include the arguments for different reconstruction techniques, and the potential benefit of superior mesenteric artery (SMA) clamping, splenic vein (SV) preservation or ligation, and intraoperative heparin and postoperative anticoagulant use.

In the 1970s, Fortner drew greater attention to vascular resection during pancreatic surgery. (6). During those years, however, the method was not widely
accepted due to the high morbidity and mortality of PD with vascular resection. However, as advances were made in preoperative evaluation, surgical technique, postoperative management, and anesthesia an extensive body of literature has emerged on this topic over the past three decades. PD with venous resection is now recognized as a frequently applied approach in high-volume centers.

The purpose of this study is to evaluate the results of PD with venous resection performed in our clinic and to compare our surgical results with other series in the literature in terms of mortality, morbidity, and safety.

**MATERIAL AND METHOD**

The study was carried out with the permission of the Eskişehir Osmangazi University Faculty of Medicine Ethical Committee (Date: 01.06.2021, Decision no: 02). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The data for 11 patients who underwent PD with venous resection between 01.05.2016 and 01.05.2021 in the Osmangazi Medicine Faculty General Surgery Department, Turkey, were subjected to analysis. Demographic characteristics, date of diagnosis, date of recurrence, follow-up period, histopathological features of the specimen, tumor localization, preoperative imaging reports, resectability status (6), neoadjuvant therapy status, preoperative clinical TNM stage (7), characteristics of surgical intervention, vascular resection type (8), and postoperative complications were recorded for all patients (Table).

<table>
<thead>
<tr>
<th>Table: Summary of patients’ and tumor characteristics</th>
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<td><strong>Age</strong></td>
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<td><strong>Gender</strong></td>
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<td>Female</td>
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<td>Male</td>
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<tr>
<td><strong>Type of reconstruction</strong></td>
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<td>Type 1</td>
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<td>Type 2</td>
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<td>Type 3</td>
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<td>Type 4</td>
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<td><strong>Invasion (histopathology)</strong></td>
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<tr>
<td><strong>Follow-up time, months</strong></td>
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<td><strong>Status</strong></td>
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<td>Exitus</td>
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<tr>
<td>Alive</td>
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<td>Recurrence</td>
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<td>Metastasis</td>
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<td><strong>Diagnosis</strong></td>
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<tr>
<td>Exocrine pancreas adenocarcinoma</td>
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<td><strong>Differentiation</strong></td>
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<td>Poor</td>
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<tr>
<td>Moderate</td>
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<td>Good</td>
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</table>

Data are presented as mean±standard deviation (minimum-maximum) for continuous variables and as frequency (percentage) for categorical variables.
tumor stage was IIB (45.45%). The tumor was in the
hepatic area for metastasis were observed during surveillance.
No patient underwent pylorus-sparing surgery. Regional
lymph nodes, hepatoduodenal ligament, celiac axis
(CA), and SMA were routinely dissected. The para-aortic
area was dissected in cases with suspected metastasis at
imaging. En-bloc resection and reconstruction were
performed in cases with obvious portomesenteric venous invasion at preoperative imaging and in the
intraoperative period. However, tangential resection-
venorrhaphy or reconstruction with a patch was
performed for tumors invading the right axis of the
portal vein (PV) or the SMV. Primary anastomosis was
employed in cases in which segmental venous resection
was performed due to invasion. However, reconstruction
was performed with a cadaveric iliac vein graft in one
case in which tension-free anastomosis was not possible
despite maximum mobilization.
Postoperative complications were classified according
to the Clavien-Dindo system. Patients with suitable
performance status received adjuvant chemoradiotherapy
after the operation. CA.199 levels and abdominal CT
scans for recurrence/distant metastasis were employed
during follow-up.

RESULTS
Eleven patients (five female and six male) with a mean age of
64.09±9.27 years (range 47-78) were included in the study.
Four (36.36%) patients underwent type 1 reconstruction,
one (9.09%) type 2 reconstruction, five (45.45%) type 3
reconstruction, and one (9.09%) type 4 reconstruction.
Pathology reports identified venous invasion in eight
(72.73%) patients. Mean time between diagnosis and
surgery was 14.91±11.33 (range 2-36) days, and the mean
follow-up time was 17.64±13.31 (1-40) months. One
(9.09%) patient died on the 17th postoperative day due to
grade C pancreaticojejunostomy leak. No recurrence or
metastasis were observed during surveillance.
Exocrine pancreas ductal adenocarcinoma (PDAC)
was diagnosed in all patients. The most common
tumor stage was IIB (45.45%). The tumor was in the
head of the pancreas in all cases. Mean tumor size was
32.27±9.67 (range 22-50) mm. Three (27.27%) patients
exhibited extracapsular invasion, and nine (81.82%)
perineural and lymphovascular invasion. The resection
margin was R1 in two (18.18%) cases, both of which
were retroperitoneal. Ducto-jejunostomy and simple
gastrojejunostomy + Braun anastomosis were performed
on all patients. The pylorus was not preserved in any
patient.
Two (18.18%) patients received neoadjuvant chemotherapy, nine (81.82%) received adjuvant chemotherapy, and seven (63.64%) received adjuvant radiotherapy. Macroscopic leakage and grade C fistula
were present in one (9.09%) case (this patient was exitus).
Two (18.18%) patients experienced postoperative surgical site infection and two (18.18%) delayed gastric emptying
(DGE). Three (27.27%) patients had grade II complications.
One (9.09%) patient underwent preoperative endoscopic retrograde cholangiopancreatography (ERCP) and stent.
Mean intraoperative blood loss was 322.73±90.45 (range
200-450) ml.

DISCUSSION
The purpose of this study was to conduct a retrospective
evaluation of the morbidity-mortality rates and
reliability of venous resection with PD procedures
performed in our clinic. PDAC has a very poor
prognosis, and the only curative therapeutic option is
currently surgical resection. The addition of venous
resection in addition to standard PD in some cases
with venous involvement provides R0 resection with
advanced dissection of the peripancreatic vessels and
peripancreatic fatty tissue.
Recent reports have shown that venous resection is
safe as a therapeutic option in borderline resectable
pancreatic cancer (9-11). Xie et al. (11) showed that
patients undergoing radical resection of PDAC and
PV resection exhibited significantly improved survival
compared to those undergoing chemotherapy or
palliative surgical procedures alone.
Resection margin is one of the most important
prognostic factors in surgically treated PDAC. (12). The
aim of PV-SMV resection is to achieve negative resection
margins in patients with suspected PV-SMV invasion.
The reported R0 resection rate ranges from 49% to 87.5%
(13, 14). The R0 rate in the present study was 81.8%. The
residual tumor was in the retroperitoneal area in all our
patients with a positive resection margin (18.2%).
The reported rate of venous invasion detected at
pathological examination after venous resection in the
literature is between 3% and 80%. (15-24). The figure in
the present study was 72.7%.
There are two types of venous resection, partial and segmental, involving various reconstruction techniques, including venorrhaphy, patch repair, end-to-end anastomosis, and autologous or prosthetic interposition graft (8). All exhibit similar results in terms of patency (14, 25). We performed partial vein resection on five of our patients and segmental vein resection on six. Similarly to the majority of previously published series, we performed four types of venous resection (13, 26, 27). However, our segmental resection rate was higher (45.4%) than that in previous series. This is probably attributable to the experience and orientation of the surgical team.

In our study, intraoperative blood loss was calculated as 322.73±90.45 ml. Intraoperative transfusion was not employed in any case.

Long-term postoperative anticoagulation is recommended only for patients with prosthetic grafts and those with PV thrombosis (13). No prosthetic graft was employed in any patient in the present study, and oral anticoagulant use was not required.

All patients in our study underwent wirsungojejunostomy. The pylorus sparing method was not employed in any case.

The patients were followed-up for an average of 17.64±13.31 months, during which no recurrence was detected. One (9.09%) patient died on the 17th postoperative day due to grade C pancreaticojejunostomy leak. No other mortality was observed during follow-up.

CONCLUSION
In conclusion, the results of this study show that venous resection with PD is associated with acceptable morbidity and mortality rates. PD with venous resection/reconstruction is safe and the only available option for curative treatment in patients with pancreatic cancer and venous invasion.

ETHICAL DECLARATIONS
Ethics Committee Approval: The study was carried out with the permission of Osmangazi University Non-interventional Clinical Research Ethics Committee (Date: 01.06.2021, Decision No: 02).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES


